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GW Model
Assignment 1

1. The model is in steady state in both cases heterogeneous and homogeneous because when looking at the downward flux vs. column height we can see it is constant in both cases spatially throughout the column. In a homogeneous case flux must be the same and the K is the same everywhere therefore the gradient must be linear. If you "break" the column into an infinite number of cells the flow in and out of each cell would be equal. The excel graph of flux versus height shows this as a constant value.

2. We can see that steady state flux agrees with the direct calculation because the value for each cell iteration in the q column is equal to the q in the direct solution.

$$Direct\ solution\ for\ flux(q) = -K_{eq}\left(\frac{dH}{dz}\right)$$

$$harmonic\ mean\ (Keq) = \frac{total\ \#\ of\ cells}{\dfrac{\#\ cells\ K1}{K1} + \dfrac{\#\ cells\ K2}{K2} + \dfrac{\#\ cells\ K3}{K3}}$$

Direct solution for flux				z	K zone cell	K cell	H	q
	K	num cells						
zone 1	0.5	12		60	1	0.5	100	
zone 2	0.01	0		55	1	0.5	91.66667	0.833333
zone 3	0.0001	0		50	1	0.5	83.33333	0.833333
				45	1	0.5	75	0.833333
Keq	0.5			40	1	0.5	66.66667	0.833333
q	0.833333			35	1	0.5	58.33333	0.833333
				30	1	0.5	50	0.833333
				25	1	0.5	41.66667	0.833333
				20	1	0.5	33.33333	0.833333
				15	1	0.5	25	0.833333
				10	1	0.5	16.66667	0.833333
				5	1	0.5	8.333333	0.833333
				0	1	0.5	0	0.833333

3. Water flow in the column is being limited by the layer with small K which contains smaller pore sizes which limits water flow. Energy is related to the square of the gradient and because of this relationship this means that the energy loss is squared. This mathematical relationship means that the limiting K layer has a huge amount of energy lost because energy loss is a squared term. Due to this relationship between energy loss and hydraulic conductivity the Keq will always be closer to the layer in which the most energy is lost which is the layer with the lowest K value.

	Direct solution for flux			z	K zone cell	K cell	H	q		zone 1	zone 2	zone 3
	K	num cells										
zone 1	0.001	6.5		60	1	0.001	100			1	0	0
zone 2	0.01	5.5		55	1	0.001	85.81883	0.002836		1	0	0
zone 3	0.0001	0		50	1	0.001	71.6371	0.002836		1	0	0
				45	1	0.001	57.45463	0.002836		1	0	0
Keq	0.001702			40	1	0.001	43.27132	0.002837		1	0	0
q	0.002837			35	1	0.001	29.08715	0.002837		1	0	0
				30	1	0.001	14.90218	0.002837		1	0	0
				25	2	0.01	7.099729	0.002837		0	1	0
				20	2	0.01	5.680469	0.002839		0	1	0
				15	2	0.01	4.260701	0.00284		0	1	0
				10	2	0.01	2.840584	0.00284		0	1	0
				5	2	0.01	1.420292	0.002841		0	1	0
				0	2	0.01	0	0.002841		0	1	0